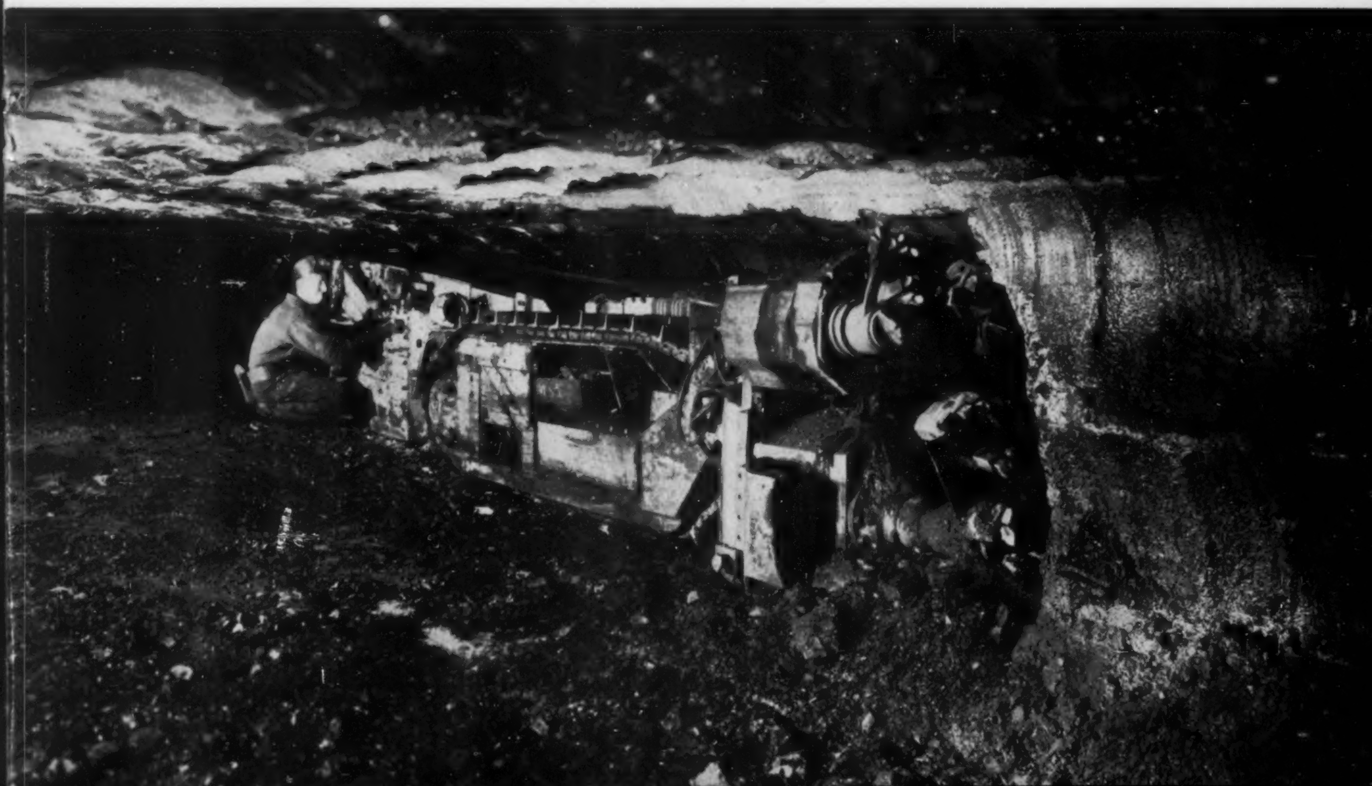
february 1959

nlgi spokesman

journal of the national lubricating grease institute



Future Meetings

FEBRUARY, 1959

1-6 ASTM Committee D-2 meeting, Sheraton-Jefferson Hotel, St. Louis.

16-17 Packaging Institute, Petroleum Packaging Committee, Goodhue Hotel, Port Arthur, Texas.

26-27 API Division of Marketing, Lubrication Committee Meeting, Sheraton - Cadillac Hotel, Detroit.

***MARCH, 1959**

3-5 SAE Passenger Car, Body, and Materials Meeting, Sheraton-Cadillac, Detroit, Mich.

APRIL, 1959

5-10 American Chemical Society 135th National Meeting.

15-17 National Petroleum Association, Semi-annual Meeting, Hotel Cleveland, Cleveland, Ohio.

21-23 ASLE Annual Meeting and Exhibit, Hotel Statler, Buffalo, New York.

MAY, 1959

4-6 API Division of Marketing, Lubrication Committee Meeting. San Marcos Hotel, Chandler, Ariz.

15-24 International Petroleum Exposition.

27-29 API Division of Marketing, Mid-year Meeting. The Savery, Des Moines.

31-June 6 Fifth World Petroleum Congress. The Coliseum, New York City.

* Tentative

JUNE, 1959

1-5 Fifth World Petroleum Congress Exposition, The Coliseum, New York City.

14-19 SAE Summer Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

21-26 ASTM Annual Meeting Chalfonte-Hadden Hall, Atlantic City, N. J.

SEPTEMBER, 1959

19-21 ASLE and ASME Joint Lubrication Conference, Sheraton-McAlpine Hotel, New York City.

OCTOBER, 1959

26-28 NLGI Annual Meeting, Roosevelt Hotel, New Orleans, La.

11-15 ASTM Committee D-2 Meeting, Sheraton - Palace Hotel, San Francisco.

28-30 Society of Automotive Engineers, National Fuels and Lubricants, La Salle Hotel, Chicago.

APRIL, 1960

19-21 ASLE Annual Meeting and Exhibit, Netherland-Hilton Hotel, Cincinnati, Ohio.

APRIL, 1961

11-13 ASLE Annual Meeting and Exhibit, Bellevue Stratford Hotel, Philadelphia, Pa.

OCTOBER, 1961

30-Nov. 1 NLGI Annual Meeting, Edgewater Beach Hotel, Chicago, Illinois.

4-6 API division of Marketing, Lubrication Committee Meeting.

15-17 National Petroleum Association, Semianual Meeting.

26-27 API Division of Marketing, Lubrication Committee Meeting.

27-29 API Division of Marketing, Midyear Meeting.

NLGI PRESIDENT'S PAGE

By F. E. ROSENSTIEHL, *President*

The Second Survey

Company Cooperation Urged for NLGI Survey of 1958 Production

Each active member should now have in his hands the production survey form covering production during the calendar year 1958 of various types lubricating greases and fluid gear lubricants. The form is the same as that which was used so successfully in first surveying the total production of greases manufactured in the U. S. in 1957. The NLGI thought so highly of this first survey that your Board of Directors authorized the second. Each succeeding survey, of course, becomes more valuable, since the more data collected the more definite are the trends indicated.

This year's survey will also include NLGI active manufacturing members in Canada, though the Canadian production figures will be kept separate from the U. S. totals.

The survey will be conducted in complete secrecy through the management services division of Ernst & Ernst, the national accounting firm, who very successfully handled last year's survey.

It is estimated that the production represented in the 1957 survey covered aproximately 85 per cent of total domestic production. Obviously, if in this year's survey the total production represented can be increased to well over 90 per cent, as we hope, the figures will become just that much more valuable.

The manner in which the survey is conducted, as well as the reputation of the company handling them, insure that all figures will be kept completely confidential, so that no member need fear releasing his production data.

If you are an active producing member, I urge you to see that your own company actively cooperates in helping make the new survey a success. ■

nlgi spokesman

Volume XXII February, 1959 Number 11

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IN THIS ISSUE

THE COVER

CONTINUOUS mining machines like the one shown on our cover mark the resurgance of what was once a "sick" industry . . . underground coal operations are being revitalized, thanks to increased productivity brought on by mechanization. Author J. C. Van Gundy points up the need for lubrication by these machines and predicts a whopping increase in lubricant sales to the underground mining industry, in his paper dealing with this subject and the steel industry, beginning on page 499. The introduction of new equipment has been instrumental in coal coming back.

News About NLGI

New Venezuelan Member

C. A. Nacional de Grasas Lubricantes of Caracas, Venezuela, has joined NLGI as an Active member firm. Mr. Ladislao Szikora is the company representative. The inclusion of this organization brings to a total of eleven the number of grease manufacturers who are participating in the Institute's programs as members, from Canada and abroad.

NLGI Representatives Are Announced

Esso Standard Oil has named Dr. Harlan M. Smith, section head of industrial lubricants, Esso Research, as NLGI technical representative. He replaces Dr. John Kolfenbach, who has been given a new assignment. Dr. Kolfenbach served the Institute as sub-committee chairman for the new fundamental research group during its formation and was instrumental in arranging last year's successful meeting for pure research during the 1958 annual meeting.

Sun Oil has named Mr. B. W. Van Ormer, technical representative of the industrial products department, as the company representative to NLGI. He replaces Mr. J. V. Curley, who is retiring.

Firm Changes Membership

Prairie States Oil and Grease, an Active member since 1948, has changed its membership to an affiliate, Core-Lube, Inc. Both firms headquarter in Danville, Illinois. The Active classification will be continued for this member firm.

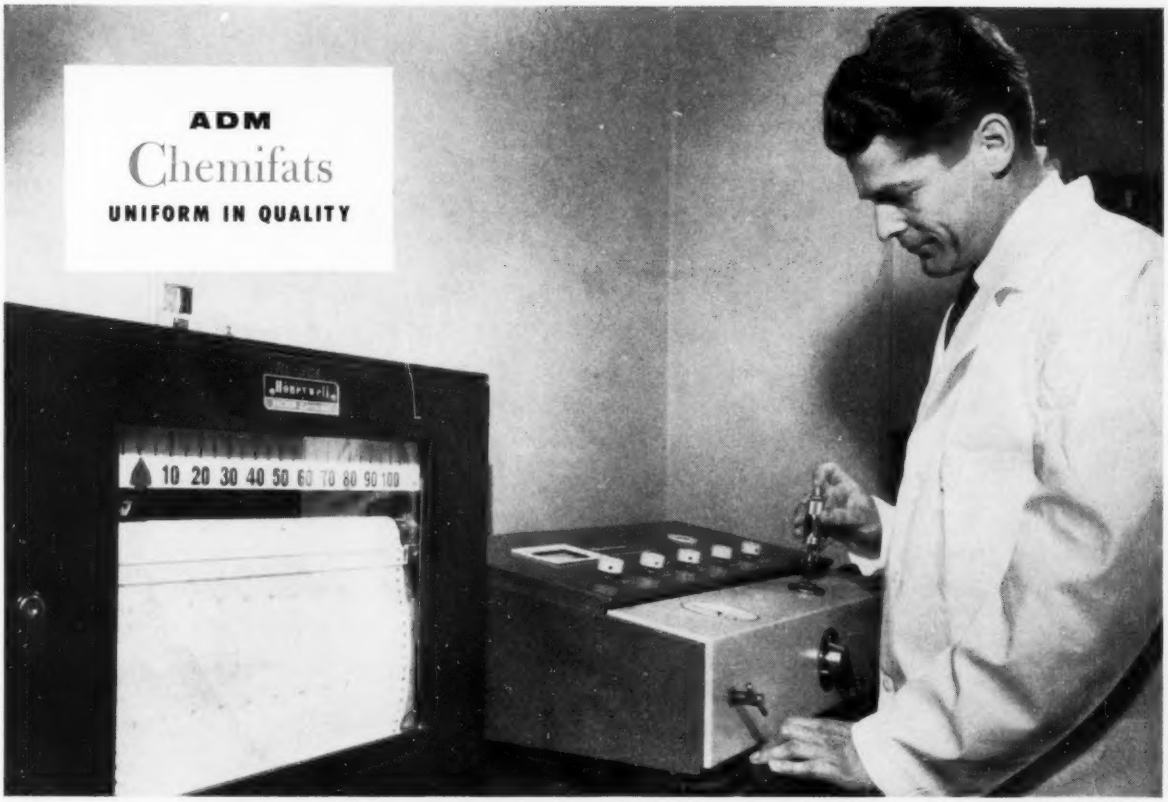
NLGI Second Survey

Active (manufacturing) member firms of NLGI have received the forms for the Institute's second annual survey on the production of fluid gear lubricants and lubricating greases (for more on this subject, note page 494), for 1958.

Retaining the same confidential character of the 1957 survey, NLGI's first, all mailings will originate with the management services division of Ernst & Ernst, nationwide certified public accounts. E&E bonded personnel will in return get the anonymous returns as they are mailed to the firm's Kansas City office. Tabulations completed, the data sheets are destroyed and the NLGI national office is then given grand totals. Last year, the 1957 survey brought a 76 per cent return and it is expected that 1958 replies will be even higher.

All categories of membership will receive the totals, once they have been completed. This year, the Canadian Active members will participate in the survey, with Canadian totals given separately in the final report.

Although slightly over three-quarters of the manufacturers in the United States reported in the 1957 survey, it was officially estimated that over 85 per cent of production was given.



Gas chromatography... one more reason why you can count on ADM for Quality

The gas chromatograph shown above is another reason why ADM can always supply fatty chemicals of uniform high quality. This remarkable instrument does an accurate analysis of a fatty acid, for example, in from a few minutes to an hour and a half. An analysis of the same accuracy by older methods would take weeks or months—if it could be done at all.

This is why ADM has equipped research and control labs alike with gas chromatographic equipment. Such advanced analytical techniques, coupled with ADM's control of raw material quality mean that ADM safeguards the quality . . . and uniformity . . . of its Chemifats throughout the manufacturing procedure.

In the lubrication field ADM's full line of Hydrofol Fatty Acids makes possible grease formulations to meet specific use conditions. Careful processing and fractionation, checked by gas chromatographic analysis, assure you that the Hydrofol Acid you select will be uniformly what your specifications call for.

To learn more about Hydrofol Fatty Acids and other ADM Chemifats, write for our new catalog or ask to have an ADM Chemical Technical Representative call.

GET YOUR COPY of the new ADM Chemical Products catalog. This 52-page book gives specifications of the many types of aliphatic chemicals made by ADM. Write on your company letterhead today.

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Chemifats from Nature's Wondrous Warehouse

Letter to the Editor...

Editor's Note: *Recent headlines in petroleum trade journals have much of predictions of greaseless cars in the future (see* NLGI Spokesman, *December), but many experts in the industry are less concerned with this as a probability than they are with the continuing decline in oil change and lube job ratios . . . a very real problem at the present. Given below is one man's opinion on what might be considered a solution to the several problems—now, and possibly then. The author, Mr. E. E. Smith, is manager of lubricant development, Climax Molybdenum. Long active in petroleum circles, Mr. Smith has participated in several marketing developments concerning lubricating grease and has a keen interest in the progress of the industry. A former author for the* NLGI Spokesman, *he is company representative for Climax, to the Grease Institute.*

Gentlemen:

Most of us are aware of the prediction which indicates that the chassis grease market is rapidly shrinking. Now news of the fact that Ford Motor is considering the use of a non-lubricated fabric bearing in some of its 1960 cars is not encouraging for the grease industry. But instead of taking either a fatalistic or wait-and-see attitude, the industry can and should take positive steps to not only hold, but actually increase, the passenger car grease market. A thought has occurred to me which might very well prove the answer.

For the motorist a grease job is a nuisance because it means giving up his car for part of a day or perhaps even a full day to get the job done. The automobile companies recognize this great inconvenience to the motorist and in their efforts to satisfy his needs and sell more cars they are determined to design the greaseless car—all this of course at the expense of the oil industry.

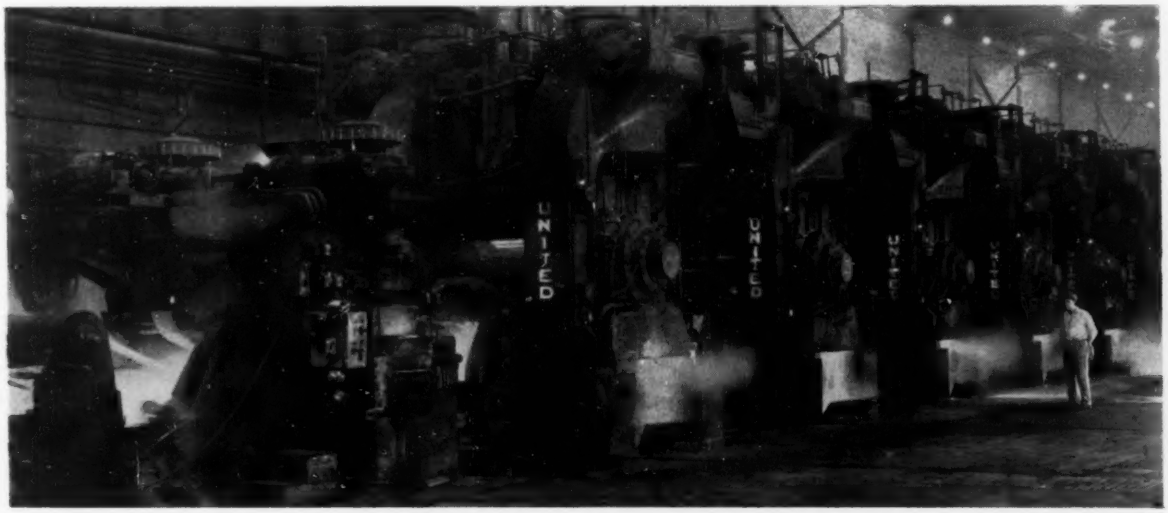
The answer then is for the oil industry to devise a way to eliminate motorist inconvenience and yet maintain the need for chassis grease. This could be accomplished, I believe, through the design of a single-fitting lubrication system whereby one master grease fitting would be mounted under the hood, near the radiator cap. The principle behind this would be to feed grease through flexible polyethylene (or some other type) tubes to all lubrication points.

Service station operators could then lubricate a car in seconds—while the gas tank is being filled—merely by pumping sufficient grease through the single fitting. I'm sure the motorist would be glad to pay 50-75¢ for a "shot" of grease if he could get it without wasting time. Service station operators, too, would find such a system much more convenient—eliminating scheduling difficulties and greatly cutting labor costs. This method of lubrication would, no doubt, stimulate greater sales of chassis grease because motorists would be more inclined to lubricate frequently and stations would be more likely to promote lubrication.

I hereby propose that the NLGI assume leadership in putting this idea into action. This can be done by conducting a crash research program for the design and manufacture of such a system to be supplied to auto producers at cost. As we all know, the automobile industry is intent on providing its customers with greater convenience by giving them a car which does not require regular lubrication. The idea just outlined, or a modification of it, could prove a satisfactory answer to all concerned—the auto industry, the motorist and the oil industry.

Sincerely,
E. E. Smith, *Manager*

Future Lubricating Grease Requirements in the STEEL and UNDERGROUND COAL MINING INDUSTRIES



54 inch four-high six-stand tandem hot strip mill

By: J. C. Van Gundy
The Texas Company

Presented at the NLGI 26th annual meeting in Chicago, October 1958

BOTH THE BASIC steel and underground coal mining industries are large consumers of grease. While total amounts used in the coal industry are fairly well documented, little is known about the amount used in the steel industry.

In this paper an attempt is made, not only to estimate present volume requirements in these industries, but to forecast future requirements. Included also are broad future trends with respect to properties of greases. This survey has been limited to the United States.

There is a close relationship between coal and steel. Perhaps some will be surprised to know that of the five largest coal producers in 1957, two were owned by steel corporations. Although greases supplied these two industries may differ somewhat in type, persons interested in one industry often are also interested in the other.

Steel Industry

Mr. A. S. Randak of Sinclair in a paper, "Analyzing the Lubricating Grease Market," presented before this group in 1956, stated statistics on the consumption of greases in the steel industry "just are not available." The author's own investigation has certainly confirmed this in that no such figures have been published in the past nor is there any central source for such information.

Before going further, the term "grease" should be defined. In this instance, it applies to thickened materials with the softest having a consistency of NLGI 0 or even semi-fluid. Lead soap gear lubricants and similar products normally sold by the pound are not included.

Total Grease Requirement

Estimated consumption figures are no better than their source. For this reason, the source of the figures to follow are explained in some detail.

In all instances it was necessary to establish personal contacts to obtain desired information. Letters drew no response. Some mills apparently do not keep adequate records to indicate their volume consumption or perhaps the right person was not contacted. Others are reluctant to release such figures. Some figures given the author were estimated. Even so, sufficient consumption figures have been obtained to indicate some idea of the size of this market and a broad breakdown by type. Altogether, information considered fairly reliable, but not always complete, was obtained on steel corporations or mills representing about fifty per cent of the total ingot production during 1957.

Available individual mill requirements were then extrapolated on the basis of total 1957 ingot production to get some idea of total consumption.

The estimate developed on the consumption of greases by the steel industry in 1957 is shown in Table I.

The foregoing is for basic steel corporations having ingot capacity. Some companies do not start with ore but buy ingots or intermediate steel for further processing. As a result, total grease used in the steel industry may be in the vicinity of sixty million pounds per year.

TABLE I
Estimated Consumption of Greases By The Basic Steel Industry in 1957

	Million Pounds Per Year
Non-Extreme Pressure Greases	24
Extreme Pressure Greases	26
Total: Approx.	50

Making an estimate of current consumption has been most difficult. Even more difficult, therefore, is the job of estimating future requirements. The following is based on average economic growth. An all-out shooting war or prolonged depression would, of course, result in drastic changes in grease consumption.

The steel industry has made rather definite forecasts of future requirements for ingot production. At first, it was thought simple extrapolation on this basis would give an indication of grease requirements up to about 1975. There are other factors which when considered, show this is not a completely valid assumption.

It is believed that currently the unit consumption of grease (pounds used for all purposes per ingot ton of steel produced) is at about its highest level. There could be periods of very high steel production in the next several years when unit consumption might be higher than today. By about 1965 and possibly before then, it is fully anticipated there will be a gradual drop in unit consumption. Some of the reasons for this along with industry trends are discussed below:

There will be some change made in the procedure used to convert iron ore into finished steel. One example is the probable commercialization within ten years of a process for direct conversion of iron oxide to steel, thus eliminating at least some blast furnace capacity. Other projects, such as the direct rolling of iron powder into sheet, are receiving active attention but none appear to be ready for mass commercialization in the next ten or fifteen years. No known process changes now being developed are estimated to drastically change grease requirements before about 1975.

On the other hand, equipment approaching obsolescence is being replaced gradually with modern versions containing much more efficient lubrication systems. Grease lubricated back-up roll bearings and gear boxes, such as on tables, for example, are becoming obsolete and modern versions are now lubricated with other types of lubricants. In short, modern equipment requires a much smaller quantity of lubricants than its obsolete predecessor. (One authority estimates this can result in as much as 75 per cent reduction.) In addition, the ratio of grease to other lubricant types required will probably be even somewhat less.

Atomized lubrication is very gradually expanding at the expense of some grease applications.

Advancing technology in grease manufacture will

probably result in more economical greases with a high degree of stability under most operating conditions. This can result in less wastage and reduced consumption.

Last, but not least, is the increasing importance of lubrication engineering in mills. The current trend, which cannot help but continue, for reduced maintenance and lubricant costs is raising the status of the plant lubrication engineer. It has been demonstrated repeatedly that the use of quality lubricants plus planned lubrication has almost always resulted in reduced maintenance costs, less lubricant consumption and an overall net savings in lubricant costs.

In summary, there will be significant growth in steel production by 1975. This will not all be obtained by simply installing additional equipment operating at present day efficiencies. A good proportion will be obtained by improving the efficiency of such equipment. The latter will result in an overall reduction in unit consumption of grease. With these thoughts in mind, a forecast of future total grease consumption has been made.

Since 1955 estimates of future ingot capacity have been published by ten known authorities. These have been averaged by the author with the results shown in Table II.

TABLE II

	Ingot Capacity, Tons	*Ingot Production, Tons (Same Basis as 1957, 85% of Capacity)*
1957	133,400,000	111,500,000
1975	210,000,000	175,000,000

On the basis of indicated ingot production (as contrasted to capacity) a simple extrapolation can be made to indicate future total grease consumption. Using a grease consumption of 50-60 million pounds in 1957, this procedure forecasts a total of 79 to 94 million pounds of grease required in 1975. These figures are represented by the three diagonal lines on Figure I.

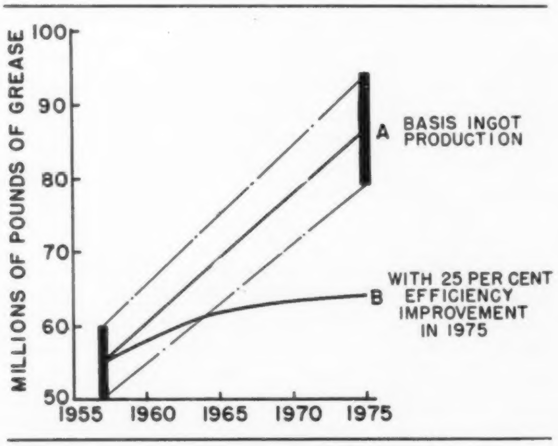


FIGURE 1, total grease consumption forecast

This, however, appears to be much too optimistic an estimate.

As pointed out previously, it is forecast that unit consumption of greases will decrease (pounds of grease per ingot ton produced). To illustrate the effect of this, the author has assumed arbitrarily a unit reduction of about 25 per cent by 1975. It is believed this will not be a material factor until in the early 1960's, then will become increasingly important. If the logic of this is valid, then it is very probable total consumption of greases may reach a peak in about 1965, then level out or actually decrease by 1975. To illustrate this, line A was drawn on Figure I as representing the median of the forecast on the basis of ingot production. Line B is an arbitrary curve drawn to show the effect of a 25 per cent improvement in efficiency by 1975. Future grease volume requirements up to 1975 should fall within the limits shown and very probably Curve B more nearly approaches what actual consumption will be. Some time after about 1975, total grease consumption should again expand along with any increase in steel production.

Future Types and Quality

It will be recalled from Table I that a little less than 50 per cent of greases used in steel mills are of the non-extreme pressure type. With few exceptions these have been developed for use in many industries, including steel. Since their properties will be dictated by these industries and not steel alone, such greases are not discussed further in this paper.

On the other hand, the majority of extreme pressure type greases have been and are being developed specifically for the steel industry and are, therefore, worthy of comment.

It is certain the use of extreme pressure greases will grow at the expense of non-EP greases. Older designs of equipment, requiring for example, block and graphite greases, will be replaced gradually by designs calling for other lubricants, such as extreme pressure greases.

Changes will come also in the relative amounts of the types used and properties of extreme pressure greases. Figure II illustrates a classification of types and estimated future trends up to about 1975.

The breakdown by type for 1957 as illustrated in Figure II can be questioned. In the survey made, such a comparison could be obtained at only six or seven corporations representing about 20 per cent of the 1957 actual total ingot production. Actually, the figures obtained indicated that about 46 per cent of total extreme pressure greases represented the 200°F. dropping point type. Further analysis showed these figures came primarily from integrated strip mills with much of the equipment being fairly modern. Discussions with many persons close to this field have revealed that most feel the actual ratio in the industry is about 2:1 in favor of the 200°F. dropping point over the higher dropping point type. It is this ratio that is used in Figure II.

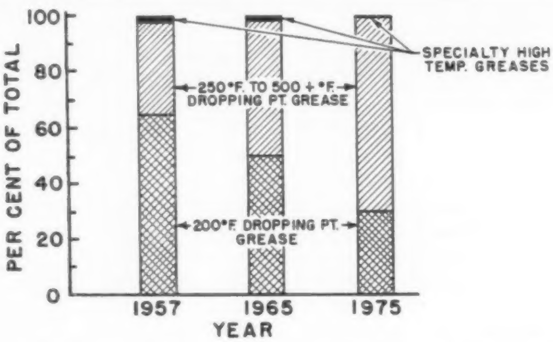


FIGURE 2, graph showing forecast of trends in use of extreme pressure grease types

Newer equipment and planned lubrication, as previously discussed, both favor the expanding use of the premium type classified in Figure II as "250-500+°F. dropping point." It is estimated this type will reach about 50 per cent of the total available extreme pressure grease market by 1965 and a somewhat higher proportion, possibly in the order of 70 per cent, by 1975.

This growth, of course, will be at the expense of the conventional 200°F. dropping point type. With respect to the latter, some demand will undoubtedly always exist on older and worn equipment where initial price is of paramount importance. Incentive plans in steel mills can promote the use of the least costly grease. Savings made in initial cost show up immediately in such plans, even although the use of a higher quality grease might result in overall savings in maintenance and lubrication costs. Probably the effect of incentive plans will be a factor in some mills for years to come.

Gradual composition changes, as grease technology progresses, will be made in the present conventional 200°F. dropping point type. Since initial cost appears to be the most important single consideration, drastic modifications are not anticipated.

The premium extreme pressure type, on the other hand, will not only increase in volume used, but is expected to materially improve in properties due to the extensive efforts of the suppliers. The goal, of course, is one grease that can be used in almost every type of equipment under almost all kinds of operating conditions. Some of the more obvious areas of improvement are as follows:

1. Greases that are capable of use at operating temperatures ranging from the lowest ambient temperatures encountered to the vicinity of 500°F.

2. No noticeable change because of the washing action of water and roll oil solutions.

3. Easier pumpability at both low and normal temperatures.

4. Shear stability under a wide variety of operating conditions, contributing to prolonged use in bearings without replacement.

5. Elimination of seasonal grades.

The third type shown on Figure II is termed "specialty-high temperature." This class is used on very hot applications above about 350-400°F., i.e. coke oven doors. Actual volume involved has been most difficult to ascertain. Some mills use none, others reported "four or five drums a month." On the basis of information obtained, it is believed this category represents less than one per cent of the total extreme pressure greases now used. Incidentally, for statistical purposes all such greases encountered were classified as extreme pressure type. Actually, some in use are not and there is even some speculation as to whether such additives are needed in these greases. With the development and wide spread use of the general purpose type discussed above and equipment design improvements, it is anticipated requirements for the specialty type will gradually diminish.

In summary, with the tremendous amount of research being done to better understand soap systems and to explore non-soap thickeners, unconventional extreme pressure agents, additives and even synthetic oils, progress is bound to be made towards reaching the ultimate goal of one grease for all uses. Some of these advances in knowledge will be reflected in improvements in the 200°F. dropping point extreme pressure type grease and even more so in the premium type. Along with this, too, will be a reduction in the unit consumption and number of greases used by any one steel mill.

Underground Coal Mining

In contrast to the gradual evolution of greases to be used in the steel industry, spectacular developments are anticipated in the underground coal mining industry.

Present and Future Volume Requirements

Consumption of lubricants is fairly well documented. Estimates have been obtained from the Bureau of Mines and from two trade journals, *Coal Age* and *Mechanization*. These are in fair agreement. One estimate is shown in Table III.

TABLE III

Estimated 1957 Consumption of Lubricants In Underground Bituminous Coal Mines

Hydraulic Oil	14,800,000 gal./year
Lubricating Oil	7,328,000 gal./year
Grease	25,481,000 lbs./year

Courtesy of: *Coal Age*

No study has been made of lubricant requirements in anthracite mines. This cannot be too important a factor when one considers anthracite production represents only about five per cent of the total, and it appears to be on the decline.

The definition of the term "grease" as used in published surveys is not clearly defined. It is assumed this covers all lubricants normally sold by the pound. This then includes leaded gear lubricants, large quantities of which are currently in use. (Note that this definition, which is used in this paper for coal, differs from that used for the steel industry.)

Tremendous growth in predicted in the coal industry. Estimated future total coal production is shown in Table IV. These figures include both underground and strip mining of bituminous coal. The ration produced by each procedure is not anticipated to change appreciably before 1975.

TABLE IV

Estimated U. S. Bituminous Coal Production

	Millions of Tons
1958	430
1959	510
1960	540
1965	710
1970	900
1975	1,000

Courtesy of: *Coal Age*

On the basis of future expansion of coal production alone, one might assume lubricant consumption would double by 1975. Other factors, however, will contribute to increased consumption rate.

Best estimates are that underground mines are less than 50 per cent fully mechanized. This picture is changing rapidly, and it is anticipated mines will be essentially fully mechanized by 1975.

In addition, much more coal will be mined with continuous miners than in the past. This procedure requires about 50 per cent more grease as defined above than conventional equipment used in the process of "shooting" and mechanically loading coal. The significance of this is apparent when one considers continuous miners were first introduced in 1948, with 382 in operation in 1955, about 600 currently and a predicted 2,500-3,000 will be in operation in the next ten or so years.

More efficient use of cutting machines is a problem today, and particularly so on continuous miners. Efforts are being made to decrease down time on these machines because of delays in coal handling, timbering or roof bolting, etc. Any reduction in delays due to faulty equipment will also reduce down time. Improved operational efficiencies will be accompanied by increased lubricant consumption.

These are four growth factors which will materially increase total lubricant consumption. Offsetting these factors to a degree, however, will be a reduction in consumption due to improved preventive maintenance practices. It is safe to say a majority of mechanized mines at present have little, if any, preventive maintenance or adequate lubrication programs. Many operators still buy the cheapest lubricant possible with no thought that quality lubricants can save on repair bills. Machines often are lubricated on a hit or miss basis. Numerous instances have been seen where the lubricant in gear cases is never drained. It is continued in use until it becomes so badly contaminated with coal, water, etc., the gears or bearings in the case fail. This situation is changing. In the future much more attention will be given quality lubricants and preventive maintenance.

Considering all factors, it is estimated the potential for lubricants in underground mines should triple in volume by 1975.

With respect to greases specifically, continuation with the same types as used today would mean the estimated volume in 1975 should be about 75,000,000 pounds per year. As pointed out later, however, straight and compounded cylinder type oils are used in many gear cases. In the future, the trend will be away from this type to semi-fluid greases. This means the potential for greases, as defined above, will increase more rapidly than requirements for other types of lubricants.

Types and Quality of Lubricants

Current mining machines and particularly continuous miners are adequate to do the job intended. The big problem is not the machines themselves, but how to utilize them to get maximum production. Discussions with mining machinery manufacturers have revealed that while design refinements will be made in the future, no changes affecting drastically the type or quantity of lubricants required are projected. Even so, there are trends which will affect the type of lubricants supplied.

One is towards the use of alternating in place of direct current in mines. Silicone insulated electric motors, used with alternating current, require a high temperature grease. Other than this one factor, electric motor lubrication is no problem. Electricians normally lubricate motors and carry grease with them. It is not necessary, therefore, to consider this requirement when talking of the minimum number of lubricants required underground, as discussed later.

The balance of this paper concerns lubrication of machinery located at the face of mines to cut coal, and haulage equipment such as continuous belts, loaders and shuttle cars. It does not include locomotives, mine cars and miscellaneous equipment which either receive specialized attention or are lubricated above ground.

Excluding hydraulic systems and electric motors, two lubricant requirements remain. In gear cases straight mineral oils, compounded cylinder oils or lead soap gear lubricants are now used extensively. Semi-fluid thickened greases are also increasing in use. In grease lubricated bearings cup greases, usually No. 1 NLGI, or in some instances ball bearing type greases predominate. More often than not the most economical product is chosen. This situation is even now changing as evidenced by the number of new branded or experimental greases being offered to the coal industry. This activity will increase and some of the major directions it will take are discussed in ensuing paragraphs.

The overall use of quality type products will definitely increase in the future. This will result from improved maintenance practices, elimination of excessive contamination in lubricants and reduced leakage.

One of the major desires in any mine is the use of a minimum number of lubricants. Quite a few mines today are operating with one lubricant for use in both gear cases and all bearings on all types of equipment. One outstanding example of this type of lubricant now is an SAE 140 lead soap base extreme pressure type gear lubricant. This trend of using one lubricant for both purposes will continue to grow.

Many machines now being manufactured require extreme pressure lubricants in gear cases. In order to keep the number of lubricants in any mine to an absolute minimum, this means an extreme pressure type lubricant will be required by operators for use in gear cases of all equipment. Even where extreme pressure lubricants are not specified by the manufacturer, such machines are always subjected to both overloading and shock loading and extreme pressure lubricants have been found beneficial. Currently many operators insist on extreme pressure properties in gear lubricants. Within a few years it is predicted all lubricants used underground for gears and bearings will be of the extreme pressure type.

As a result of this, the use of straight mineral and compounded cylinder oils will decrease in favor of semi-fluid extreme pressure lubricants. This, as stated earlier, will increase overall grease consumption at the expense of other types of lubricants.

There is a definite desire on the part of operators for light or bright colored lubricants. Such products have definite "sex appeal" in mines where the background is dark. Technically, bright colored lubricants have the advantage of easy identification and thus avoid misapplications. In addition, when flushing bearings it is very simple to determine when contaminated grease has been displaced.

Very few machines are lubricated currently with any type of centralized or power equipment. Hand lubrication is a very time consuming procedure. The author is convinced the rising cost of labor will eventually force mines to convert their equipment to either centralized systems or some type of a power take-off system. No separation under pressure and easy pumpability will be two properties of greases receiving more attention in the future than in the past.

In summary, it is anticipated one lubricant will eventually predominate in the future. This will be suitable for use in gear cases and miscellaneous bearings of all types of equipment. It will be semi-fluid in nature with a sufficiently light consistency to feed to gears and splash lubricated bearings in gear cases, yet with a consistency heavy enough to stay in bearings. It will have full extreme pressure properties and will be light or bright in color.

Such a lubricant probably will not be accepted over night by the coal industry, but rather on a more gradual basis. Many operators in the immediate future will desire two lubricants as they do today. In such cases the above type can be used for gear cases and a companion grease having similar properties, but heavier in consistency, will be required for use in bearings. Demand for the latter very probably will be greatest initially, then gradually diminish.

These greases will fulfill the requirement for quality products. As is true in most industries, there is always some demand for an economy or secondary line. For some time to come this requirement will be met by greases generally in use today.

These, then, are one person's predictions of the future for greases in the steel and underground coal mining industries.

About the Author

J. C. Van Gundy *graduated from Rice Institute in 1935 with a BS degree in chemical engineering. He was then employed by the Texas Co. During his first eight years with the company he worked at both Port Arthur, Texas and at the Texaco research center, Beacon, N. Y., doing research work primarily on waxes, aviation fuels and greases. In 1949 he became staff engineer, technical service division, in New York City. In 1951 he was transferred to Chicago and in 1955 to Pittsburgh as a representative of the technical service division. His present assignment is confined to the basic metals industries, such as steel and aluminum and their captive allied interests, including coal mines. He is a member of ASLE and AISE. Mr. Van Gundy is the holder of one patent and has been the author of numerous articles on hydraulics and greases.*

Milling of Greases—1

The Mechanisms of Dispersion

By: K. H. Birkett
Battenfeld Grease & Oil Corp., Inc.

Presented at the NLGI 26th annual meeting in Chicago, October 1958

RECENTLY A STORY was published in the Reader's Digest about a metallurgist for a large steel company who during World War II was responsible for the quality of the armorplate his company manufactured. The fellow worked conscientiously at his job but, nevertheless, every few months he would receive a call from the Erie Proving Ground to appear before a board of Government officials. There he would be asked to explain why their armorplate would not withstand the 20-millimeter cannon which the Government used as a testing standard.

These occasions were highly embarrassing and they always resulted in a period of desperate activity in the armorplate laboratory that lasted until a stronger steel was developed. The new sample usually brought about a period of relative calm. But it was always shattered eventually by the dread telephone call from the Proving Ground.

On one of these visits the metallurgist found himself in the anteroom with a man who was obviously in good spirits. Being in a glum mood the metallurgist asked him a little bitterly what he found to be so cheerful about.

"Well," he said, "I work for an explosives company, and we've been having the worst trouble. Every few months we get a call from the Proving Ground telling us that our bullets won't penetrate the armorplate they use for testing. But," he grinned, "we've licked it again!"

This little story could be equally appropriate for the lubricating grease manufacturer, for he is always being prodded to make improvements in his product to meet new and more difficult problems. Associated with lubricating grease as it was with the armorplate is the word quality. Now normally this word is used in conjunction with some unknown—merely used as a blossomy word. But the word quality can really mean something in a lubricating grease. It can not only refer to the materials of composition of the lubricating grease but it can also refer to the methods of manufacture and the appearance and performance of the final product. Most manufacturers try to incorporate all three of these components when they refer to quality.

This report will be concerned with certain phases of manufacture and how they affect the appearance and performance of a lubricating grease. The title, "The Mechanisms of Dispersion," encompasses both the thermal and mechanical dispersions of soap particles in lubricating grease. Actually, thermal dispersion can be considered on the opposite side of the line from mechanical dispersion. This can be considered in this manner. First, an excellent lubricating grease can be prepared by heating soap with oil in a controlled pattern in order to induce a certain crystal growth. This generally is time consuming and very critical in operation. On the other hand, lubricating grease can be prepared from soap and oil by dispersing

the particles mechanically so that a gel structure forms. This process is also time consuming and elaborate. Generally, the middle of the line is followed for most lubricating greases by thermally dispersing the soap in the oil to a certain point and then mechanically dispersing the soap further. This results in a quality product that has good appearance and good performance characteristics.

But wait, just exactly what is a lubricating grease and how does this dispersion fit into the picture?

A possible description of grease structure shows that the ultimate particle of soap thickener is an elongated lathlike crystal in which both lath surfaces are covered with the methyl groups of the hydrocarbon chains. On the ends are the metal-organic groups. This structure when strewn throughout an oil will form what can be termed a colloidal system. Incidentally, colloidal particles are in the range of micron size.

Substances are produced in the colloidal state either by gathering smaller particles, molecules or atoms into particles of colloidal dimensions or by mechanical subdivision of larger particles. The first process is called condensation or precipitation and the second process, dispersion.

In general, the finer the particle the more powerful its gelling action. This relationship has been shown quantitatively for a series of lithium greases which were increasingly stiff in consistency as the surface area per unit volume increased. This effect may be explained in terms of a more efficient use of material in a latticelike structure when the particles are finely divided. Material is just wasted if an excessive amount is used, just as material is wasted if you try to nail a birdhouse together with spikes. The coarse fibers are not only less economical, but they generally yield grease having poor flow properties.

The organization characteristics of colloids can be described by saying that colloidal matter consists of three coordinating factors: (1) particles, (2) a continuous media, and (3) a stabilizing agent.

The particles which are the distinctive units of colloids are not, in general, single molecules, but commonly each consists of a large number of molecules. They may be wholly separate from each other and, therefore, independent; or more usually they may be grouped to form still larger structures. In all cases the material acquires new and characteristic properties.

The continuous medium of lubricating grease is the lubricating oil. Its continuity is broken only by the previously mentioned particles themselves or by their points or surfaces of attachment to each other.

The stabilizing agent must be of a dual nature, having affinity for both the particle and the medium which are united by it. In the case of lubricating greases, this stabilizing agent is supplied by polar groups which exist on the surface of the soap particle.

When a colloid contains particles which tend to join when they touch in favorable positions, forming aggregates, a high apparent or structural viscosity results. In the gel of this nature the unit is the primary particle but these are sufficiently linked so that the whole liquid is enmeshed in the loose framework formed by the aggregation.

Two problems present themselves in the synthesis of stable colloids; (1) preparing the material in the colloid state; (2) maintaining the material in the colloidal state.

Many factors enter into the process of crystallization of soap particles. Among these are the following: the effect of the viscosity of the medium, the variation in the solubility of the primary particles, polymerization of the crystallizing molecules, molecular complexity of the reactants, absorption, the presence of dust particles, the extent of agitation or mixing, the specific tendency to form nuclei and the specific tendency to grow on nuclei. All of those who manufacture lubricating greases know the effects of these variables by the resulting variations in the final manufactured product.

As in the case of all crystal systems the effect of temperature on particle formation in grease is very important. Fiber formation is aided by heating to a temperature near the solution point where well defined fibers are able to be formed. This again introduces a critical requirement, for the temperature and crystallization rates are very important in forming the proper crystal structure.

The optimum form of fibers in a lubricating grease will depend upon the composition of the soap, the particular oil employed and on the processing techniques. It can be expected that the most desirable form of fibers from a shear stability standpoint will be those having a large ratio of length to diameter. On the other hand, the form of fibers which will hold the oil most firmly will probably have a ratio as small as possible. Consequently, some concession as to fiber length must be made to give the best product.

We now come to the middle of the line manufacture of lubricating greases where first the best possible structure of soap in the oil is obtained by thermal means and then the product is further processed mechanically.

Unfortunately, early in the century, mills for dispersion purposes were termed colloid mills. This apparently is a misnomer, for it has been emphasized that such mills do not disperse to the true colloidal state. Even so, manufacturers of such mills, today, usually designate them as colloid mills. The so-called colloid mill does not, as a rule, accomplish any grinding action, nor does it disperse in most instances to anywhere near the true colloidal state. What the colloid mill really does is to deflocculate, which is the breaking

apart of large agglomerates, and in a great number of instances this is all that is necessary.

Of course, in dispersion by mechanical means there must always be a liquid present. Their principle is based entirely on the so-called hydraulic shearing effect; hence, they obviously must have a liquid in which to accomplish their mission.

Mills now are well established in modern grease plants and are necessary in the processing of many greases. Generally, the use of mechanical dispersing equipment has shortened appreciably the manufacturing time of many lubricating greases. It should be realized that milling will not always compensate for improper processing up to the point of milling nor will it make good lubricating greases out of fundamentally inferior products.

All practical mechanical dispersion processes depend on shearing. When a shear component is combined with high localized pressures, marked changes in crystal structure results. There is general agreement that the primary purpose of most dispersion procedures is reduction in aggregate size to some acceptable maximum.

From direct experimental evidence it appears that the particles in a dispersion are partly in the form of primary particles and to some extent in the form of aggregates. The size of the aggregates varies with the nature of the solid and the suspending medium and it is established chiefly by the magnitude of the shearing forces to which the composition was subjected.

Several factors need consideration in a comparison of mills of different construction and operation. These are the clearance between the moving surfaces, the relative velocity with which the surfaces are moving in relation to each other, the plastic viscosity of the composition and the flow rate of the grease. These define the limits in which a mill disperses and indicates the magnitude of the shearing forces within the mixture.

The practical aspects of dispersion may be summarized in the following manner. The large aggregations of primary particles are broken down first by crushing. The conditions under which a given mill is operated establish the limit for aggregate size reduction. In the mill, the clearance between the shearing surfaces establishes the upper limit for the size of the aggregates. Further reduction in aggregate size is accomplished largely by shearing within the viscous mixture of thickener and oil, and to some extent by actual contact of the aggregates with each other during shearing. The persistence of a few aggregates, which may be more resistant to breakdown than the average, often demands repeated passes of the material over the mill and lengthens the milling operation excessively. The efficiency of the mill is lowered by these few resistant particles. There are three ways in which this situation can be remedied. First, use the highest viscosity grinding media and the highest concentration of solids in the dispersion that can be processed in a given mill. Second, select particles that are free from hard aggregates and avoid excessive compaction, and third, remove the large particles at the end of the operation by screening.

Roll mills are generally not used to any extent in grease manufacture, except perhaps on a small scale. The biggest problem with these is the small throughput. The principle of operation of the roll mill is shearing at the nip between two rolls driven at different speeds. Dispersion of a solid is accomplished by two related processes; particles larger than roll separation are crushed mechanically by the co-acting roll surfaces and at the same time the differential speed of the rolls impart a high shearing stress on the grease.

The colloid mill in its simplest form consists of a rotor in the shape of a truncated cone, turning at comparatively high speed and spaced a small distance from a stator. Material is introduced and the centrifugal action of the rotor sets up a pumping action which forces the composition between the stator and rotor. Another type of machine forces the material by an external force to go backward through the mill so that extra action may be exerted. Numerous mechanical modifications of this simple design have been built and patented.

Present types include smooth and rough discs with or without grooves. The smooth type may revolve in a slightly tapered stator; a truncated cone, smooth or grooved may move close to a smooth or grooved conical stator; or smooth or rough discs, a small distance apart may move one relative to the other.

Another type of mill consists of a high pressure piston which forces the material through an opening of small size at a high velocity. The extruded material impinges against a hardened alley ring which causes an intense action on the product.

Grease which has been made by different methods but from the same components shows completely different structures when examined by the electron microscope. Chemically these greases are the same, the only difference being that of the physical state of the soap component.

The optical microscope has also been used in the observation of the bulk structure of lubricating greases. If a grease is spread onto a microscope slide and examined under polarized light, it is noted that the whole grease mass acts as a single crystal. This is shown by the double refracting or birefringent nature that is exhibited by any crystal which has two different indices of refraction along the different crystallograhic axes. The birefringence is detected by examining the material under polarized light between two crossed

Nicol prisms. As the crystal is rotated in polarized light it becomes alternately light and dark. This is a common microscopic method of crystal examination. Crystals in a random state of distribution would show some crystals light while others would be dark at the same time. If the crystals were all aligned in the field, then all the crystals would be light simultaneously and dark simultaneously as they rotated in polarized light.

Since soap fibers are crystals in the true sense of the word with different crystal axes, they will also react the same in polarized light. Since the whole mass of grease spread out on a slide becomes completely light and dark at once it indicates that all the soap fibers are orientated in the same direction.

Some correlation has been noted between birefringence and mechanical dispersing. In some cases a lubricating grease made without the use of a colloid mill has not exhibited birefringence, but after treatment in the colloid mill the same grease now shows strong birefringence. This is strong proof that much fiber dispersion and orientation occur in the colloid mill especially since the individual fibers did not show a great change between the milled and unmilled sample as examined on the electron microscope.

An electrical charge can be shown to exist on colloidal particles. This can be exhibited by showing the movement which takes place when a colloid is placed in an electrical field.

When two dry substances are rubbed together so that they become electrically charged, one tends to become charged positively and the other negatively. In other words, one of these substances either absorbs positive ions or loses negative ions. This is what happens when you comb your hair or walk across a wool rug on a dry day. In these cases you get a potential build-up which exhausts itself as a spark. Generally the substance with the higher dielectric constant takes the positive charge.

This effective transfer of electrons is dependent upon the nature and structure of the atoms on the surface of each substance. However, generally, it is not possible to obtain any electrical charge from two like faces of a crystal when they are rubbed together. Consequently, when considering the properties of atoms in a crystal, it must be remembered that the electrical structure of an atom is modified when it is part of a compound so that if there is the least variation a difference in charge can exist. In other words, it is all a matter of the structure of the surface.

It is largely through the electrical forces that the particles of colloids are kept in a state of dispersion. The particles carrying like electrical charges all mutually repel each other, which, of course, is a factor promoting stability.

It may be that in a milling operation certain electrical charges are placed on the particles that would tend to affect their distribution. Unmilled aggomerates may be electrically neutral but by being stroked against one another in milling a charge may be placed on them. Perhaps a certain number are charged negatively while another group is charged positively. Or it may be the agglomerates may be all one charge and the oil another. If the latter case is true, the agglomerates may tend to keep apart because of electrical repulsion of like particles but may tend to join the oil because of electrical attraction. Bleeding characteristics of unmilled and milled greases tend to bear this out.

No matter what the theory or principles are in mechanical dispersion operations, the end product is the item of importance. In nearly every case where a milling operation is used, faster production is gained, lower cost of materials is provided and a much more uniform product is produced.

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About the Author

K. H. Birkett *was graduated from the University of Missouri in* 1949 *with a BS in chemistry and has done graduate work at the University of Kansas City. Since* 1956 *Mr. Birkett has been in the research department of the Battenfeld Grease and Oil corporation of Kansas City. Prior to that he spent four years with Midwest Research Institute in Kansas City. His work has consisted of formulation and testing of diverse products, chemical consulting, manufacture and application of lubricating greases.*

Milling of Greases—2

Some Practical Benefits of Mechanical Dispersion

Presented at the NLGI 26th annual meeting in Chicago, October 1958

By: J. J. Dickason
Jesco Lubricants Company

IT IS NOT THE purpose of this paper to describe the many techniques employed in manufacturing a wide diversity of products nor describe in detail the manufacturing procedure up to the time the lubricating grease is mechanically dispersed, but rather is it to point out what you, the lubricating grease manufacturer, can expect when a mill is placed in your processing lines. The manufacturing technique employed at the author's plant was very ably described in a paper entitled, "Grease Manufacture–An Art or Science?,"[1] presented by Mr. Claude L. Johnson at the NLGI Convention in 1947. That technique is still being employed today with only slight modifications.

The order in which the eleven benefits are presented should not be construed as being of decreasing importance, but rather in the order in which they were observed. Inorganic thickening agents, materials that definitely require mechanical dispersion for their utilization, are considered last because they entered Jesco's line of products quite some time after the installation of milling equipment.

[1]Published in the February, 1948 issue of The NLGI *Spokesman*.

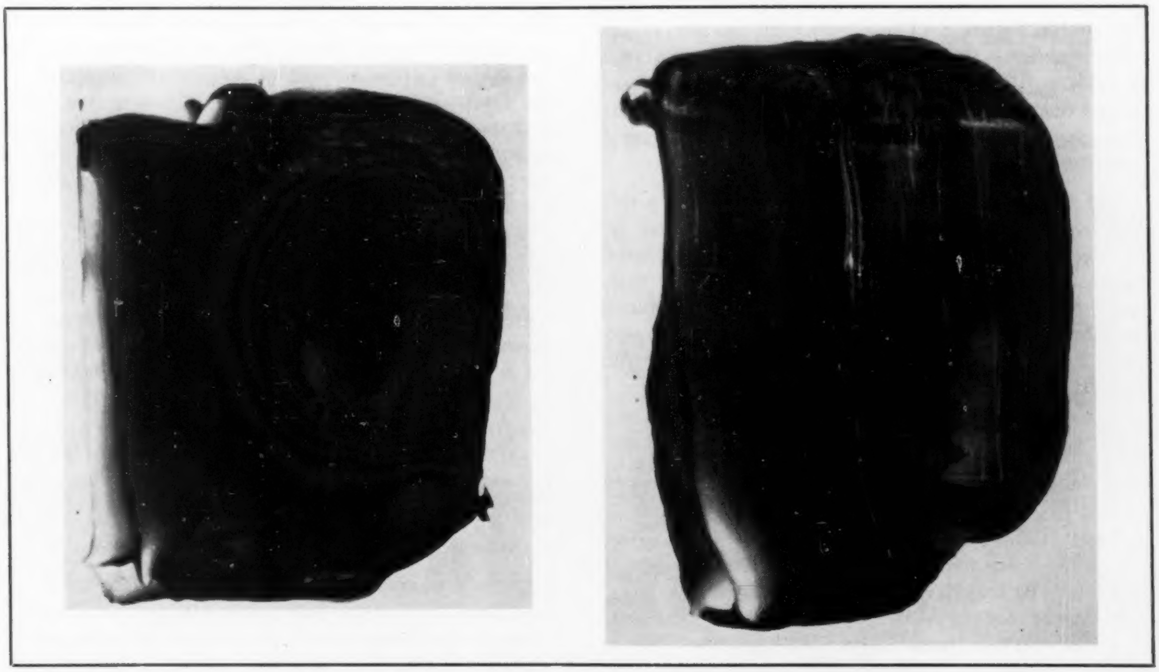


FIGURE 1, showing mechanically dispersed grease at left and not mechanically dispersed grease at right.

Improved appearance, the first benefit noticed by the manufacturer is also the first noticed by the consumer when he opens a container of your product. The consumer may remove a sample in order to feel it and make a mental note as to its consistency, but primarily he is interested in how it looks. If it is smooth and homogeneous, that is free of lumps of uncombined soap or heavier lubricating grease produced during the reduction period, he is usually satisfied.

The use of mechanical dispersion also enhances the appearance of products that contain fillers or solid additives such as graphite, molybdenum dislufide, zinc oxide, red lead or the powdered metals such as lead, zinc and copper used in tool joint compounds and thread sealing compounds. Here the improvement results from the elimination of agglomerates which normally occur when these materials are added to a lubricating grease base. Since it is felt necessary to reduce these additives to their smallest particle size to achieve the optimum benefit of their presence, such agglomerates may not only fail to function, but actually be detrimental in service.

While it is admittedly difficult to show in a photograph or on a slide, the grainy or lumpy appearance of a lubricating grease, certainly everyone present has at one time or another commented, at least to himself, concerning the smoothness or roughness of a particular product he was inspecting. It is possible, however, to demonstrate on a slide the effectiveness of mechanical dispersion on such a product as red lead tool joint compound. Figure 1—The product on the left representing material that has been mechanically dispersed as evidenced by the absence of red lead streaks and the product on the right showing the red lead streaks that are considered typical of a product that has not been mechanically dispersed.

The second benefit observed was an *increase in yield*. The first batch of sodium chassis grease that was to be mechanically dispersed was made on the same formula as those made prior to mechanical dispersion, and the processing also was the same. Figure 2 shows the laboratory data taken in connection with this particular batch. Q.C. stands for quick-cooled sample straight from the processing kettle or mill.

Batch No.	*% Fat*	*Finish Temp.*	*Q.C. Penetration*	*Remarks*	*ASTM Worked Penetration*
1	11.0	190°F	325	Unmilled	337
1	11.0	190°F	295	Milled-Cut Fat ½%	-
1	10.5	190°F	303	Milled-Cut Fat 1%	-
1	9.5	190°F	324	Milled	328

FIGURE 2

Before Mechanical Dispersion	*After Mechanical Dispersion*
1,650 lbs. — Fat	1,650 lbs. — Fat
264 lbs. — Alkali	264 lbs. — Alkali
13,086 lbs. — Oil	15,453 lbs. — Oil
15,000	17,367

FIGURE 3

In this example, and it has proven typical of the batches made since, it was possible to cut the fat content of this product one and one-half per cent or approximately 13.6 per cent of the original fat content.

At the time the second benefit, increased yield, was observed, the third benefit, *increased production* became obvious. In Figure 3, the simplified formulas for the first batch are recorded for comparison.

Here is an example of obtaining 2,367 pounds more of product with only the additional time required to pump and add the additional oil; usually 15 to 20 minutes.

While previous to mechanical dispersion, batch sizes were kept at 15,000 pounds in order to work with soap concentrations that would require a minimum of thermal dispersion before reduction with oil, it was attempted and found feasible to work with higher soap concentrations with little or no change required in the period of thermal dispersion. The next speedup resulted from adding the reducing oil faster. Whereas it was possible to make 15,000 pounds of product in 2¼ to 2½ hours, it is now possible to make 19,000 pounds in 1¾ to 2 hours. The only processing step not speeded up as a result of mechanical dispersion is the saponification period. In fact this time has been increased slightly in order to raise the blowdown temperature thus producing a more fluid product to start with and the resulting higher temperature allows the dehydration period to be shortened.

After the product was filled into containers and allowed to cool out, the fourth benefit became apparent. *The penetration of a quick-cooled sample was reliable*, with little change showing up when the final approval penetration was made on a sample taken from one of the filled containers. Figure 4 shows this data. Data is

Not Mechanically Dispersed		*Mechanically Dispersed*	
Q.C. Penetration	*ASTM Worked Penetration*	*Q.C. Penetration*	*ASTM Worked Penetration*
326	334	311	310
318	317	310	315
333	319	317	314
329	337	318	316
321	335	312	312

FIGURE 4

also presented on samples that were not mechanically dispersed.

It was hoped before this observation was made that the controls would prove as reliable as those obtained before mechanical dispersion. The data shows they are more reliable.

At the time when the ASTM penetrations for final approval were being run, the fifth benefit was observed. *Improved shear stability* as determined from the penetration obtained on a sample worked ten

Not Mechanically Dispersed		*Mechanically Dispersed*	
Worked	*10⁴ Double Strokes*	*Worked*	*10⁴ Double Strokes*
315	351	316	336
317	347	312	326
312	344	314	329

FIGURE 5

thousand double strokes. Figure 5 gives a comparison of worked stabilities on mechanically dispersed and non-mechanically dispersed batches.

On the non-mechanically dispersed batches the breakdown runs from 30 to 36 points of penetration while the mechanically dispersed products run from 14 to 20 points of penetration.

It might be well to mention at this point that, during the early days of mechanical dispersion of lubricating grease products that numerous samples were taken for laboratory evaluation. If this were a case of evaluating the effectiveness of a particular mill, the information obtained would be of interest, but since the subject matter of this paper is effects rather than causes this data is not presented. Each different product as it was mechanically dispersed for the first several batches

Before Mechanical Dispersion		*After Mechanical Dispersion*	
Fat Cont., %	*ASTM Penet.*	*Fat Cont., %*	*ASTM Penet.*
11.0	334	9.5	310
11.0	311	9.5	315
11.0	319	9.5	314
11.0	337	9.5	316
11.0	335	9.5	312

FIGURE 6

received the same treatment until it became apparent which mill clearance setting and throughput gave the optimum results from the amount of soap present.

Now that the formula and mill settings had been determined by experience with several batches, it became apparent that we had a sixth benefit; *uniformity of product*. Figure 6 shows test data on five batches made before mechanical dispersion and five after.

On the non-mechanical dispersed batches there is a spread of 26 points while on the mechanically dispersed batches only six points.

The seventh benefit, *improved storage stability*, became evident when penetrations were run on samples held for three months after their manufacture. Figure 7 shows the data obtained on three samples obtained from batches made prior to the time mechanical dispersion became a part of Jesco's processing technique and three samples after the installation of a mill.

Before Mechanical Dispersion	*ASTM Penetration*	*After Mechanical Dispersion*	*ASTM Penetration*
Original Test	334	Original Test	310
Test-3 months later	349	Test-3 months later	315
Original Test	317	Original Test	315
Test-3 months later	336	Test-3 months later	318
Original Test	319	Original Test	314
Test-3 months later	303	Test-3 months later	320

FIGURE 7

There is a change in the samples that were mechanically dispersed, but not to the degree experienced with samples that were not mechanically dispersed.

Decreased leakage tendencies, as demonstrated by the ASTM Wheel Bearing Machine becomes the eighth benefit. For this particular observation a modified procedure was used in order to better demonstrate leakage tendencies. These modification are: (1) 130 grams charge instead of 90 grams, and (2) 260°F instead of 220°F. The duration of the test and the speed are as specified in the ASTM procedure. Of necessity for these tests, an NLGI No. 2 grade of lithium grease was employed. Figure 8, in addition to showing the grams of leakage also shows the worked stabilities.

Batch	*Mechanically Dispersed*	*Unworked*	*Worked*	*Worked 10⁴ Double Strokes*	*Leakage on Modified WBPT*
1	No	276	281	311	18.0 grams
	Yes	254	267	298	10.5 grams
2	No	284	302	312	19.8 grams
	Yes	271	276	307	12.0 grams
3	No	272	298	311	19.5 grams
	Yes	268	271	306	7.6 grams

FIGURE 8

The ninth benefit is *improved pumpability*. It would be nice to have specific data to bear this out, but since apparatus for determining apparent viscosity was secured some years after the installation of mechanical dispersion equipment, it would have necessitated securing samples before and after mechanical dispersion for the purpose of determining the apparent viscosity. This was not possible at this time and it was decided

at the inception of the paper that it would be written on the basis of available data. Actually this is an attempt to record the obvious benefits without resorting to acquiring special data to substantiate any particular observation.

It should suffice to say that definitely an improvement should be noticed in pumpability if for no other reason than with the absence of heavy soap or lumps, a lubricating grease should pass through grease dispensing equipment easier. Less trouble is likely to develop from clogged screens or dispensing guns and these specific difficulties have been demonstrated with the use of the ASTM apparent viscometer particularly when the small orifices have become plugged with particles of undispersed soap or heavy grease lumps making a determination of apparent viscosity difficult if not impossible.

When retained samples were opened for making penetration tests or for observation after various storage periods, the tenth benefit, *improved antibleed characteristics*, was observed. Here is an observed benefit not substantiated by available laboratory data, at least on the products discussed thus far. Very, very rarely was free oil observed on the undisturbed surface of a container of mechanically dispersed lubricating grease, and usually when it was discovered, it was found in the grades softer than an NLGI No. 2 calcium grease. This oil bleed condition could usually be explained by such expedients as determining its moisture and excess alkali contents.

The eleventh and last benefit, *utilization of inorganic thickening agents*, is not actually a benefit, but rather an accomplishment wherein mechanical dispersion is an absolute necessity for satisfactory results. Since so much information is readily available on this aspect of mechanical dispersion, little more need be said than that the author's experience bears out what has been said many times before. Figure 9 demonstrates very well the necessity of mechanically dispersing inorganic thickening agents.

It is interesting to note that the sample that was not mechanically dispersed is getting progressively heavier as it is worked. Probably, if worked long enough, it would approach its optimum yield, but this would be a very slow process.

Sample	*Unworked*	*Worked*	*Worked* 10^3 *Double Strokes*
Not mechanically dispersed	471	438	417
Mechanically dispersed	272	275	275

FIGURE 9

If the data presented seems skimpy, it was purposely kept so to avoid tediousness. Some may tend to criticize the test data showing leakage tendencies on the modified Wheel Bearing Performance Test particularly where harder consistencies resulted from mechanical dispersion. In anticipation of this the author might ask, "To what extent does consistency influence the results of the Wheel Bearing Performance Test, when the soap content remains constant?"

Possibly the discussion of increased yield caused some concern in regards to products having a specification for a minimum soap content. In cases such as this, it has been determined, by trial and error, that such products must be mechanically dispersed at lower temperatures; with some products it may even be necessary to cool them down to ambient temperature before they are put through the mill.

It is certainly to be hoped that the impression has not been created that mechanical dispersion is the answer to all the problems that arise in lubricating grease manufacturing. The finished product, even though mechanically dispersed, can be no better than the raw materials that went into its composition or the processing it received prior to mechanical dispersion. It is impossible to take a batch that has been poorly made, to the extent that it is full of lumps, be they straight soap or masses of various soap concentrations that result from insufficient thermal dispersion or were formed through shock chilling by too rapid addition of oil during the reducing period, and make a uniform product from it. It may be smooth, but it will certainly not be uniform.

While the author's experience has been limited to five mills, three of which are commercially available, it is his opinion that any mill with sufficient throughput and violent enough shearing action will improve the majority of products on which they are used. ■

About the Author

J. J. Dickason *has been associated with Jesco Lubricants company since February,* 1941, *starting as a chemist and serving as chief chemist since* 1945. *During this time his work has consisted of developing and evaluating new products, technical sales service and conducting training courses for sales trainees. In February of this year he was elected vice president of research and development. A graduate of the University of Kansas in* 1940 *with a bachelor's degree, he has been active in and has held committee appointments in ACS and ASTM. Mr. Dickason is at the present time chairman of the Technical Subcommittee on NLGI Classification of Lubricating Greases.*

Literature and Patent Abstracts

Compositions

Lubricating Greases Containing Soaps of Oxidized White Oils

According to Mikeska, Morway and Cohen (U. S. Patent 2,850,459, assigned to Esso Research and Engineering Co.) lubricating greases for use in anti-friction bearings are improved if soaps of oxidized white oil fatty acids are included as a portion of the thickener. The suggested thickeners consist of lithium or sodium soaps of equal mixtures of hydrogenated fish oil acids and acids derived from oxidation of white oils. Also included is a lesser amount of sodium or calcium acetate.

During processing the entire mixture is heated to 500°F and after cooling is passed through a Gaulin homogenizer.

Sodium and Lithium Soaps Prepared From Oxidized Paraffin Wax

Ingold and Puddington, *J. Inst. Petroleum* 644, pp. 41-44 (1958).

Wax acids were prepared by various procedures as to catalysts and temperatures to yield acid mixtures varying in molecular weight from 246 to 322.

Using the water insoluble and non-volatile fractions, lithium and sodium soaps were made from these acids. Nine per cent of such soaps (the specific petroleum wax acids not being specified) in 91 per cent of an oil having a viscosity of 300 SSU and a V.I. of 40 were used to form lubricating greases which were compared with similar products made from either lithium or sodium stearate.

The dropping points of the lubricants were as follows:

Lithium wax soap product	180°C.
Lithium stearate product	155°C.
Sodium wax soap product	190°C.
Sodium stearate product	170°C.

Production of Lubricating Greases By Alkali Fusion of Castor Oil

Morway (U.S. Patent 2,850,454

assigned to Esso Research and Engineering Co.) suggests the formation of thickeners for oils which are obtained by the high temperature reaction of fats or oils, particularly castor oil, containing radicals of high molecular weight hydroxy fatty acids, with 100 to 125 per cent excess sodium hydroxide.

For example, 22 per cent of castor oil, 1 per cent of a sodium sulfonate blend containing half mineral oil, and 35.25 per cent of a naphthenic-type mineral oil with a viscosity of 50 SSU at 210°F. were charged to a fire-heated kettle and warmed to 150°F. At this point 5 per cent of sodium hydroxide dissolved in water to 40 per cent strength was added and heating was continued to dehydrate the mass. At 300°F. 35.25 per cent more lubricating oil was added and the mixture was heated to 530°F. After foaming subsided the product was cooled while agitating to 300°F. at which point 1 per cent of phenyl alpha-naphthylamine and ½ per cent of a condensation product of propylene diamine and salicyladehyde were added as oxidation inhibitors. Finally, the lubricating grease was screened, homogenized and packaged.

The resulting lubricant contained 0.2 per cent of free alkali and had a worked penetration of 335 and a dropping point above 500°F. This product is said to prevent friction oxidation and be suitable for lubrication of heavy truck front wheel bearings.

Silica Thickened Lubricating Greases

According to Sirianni and Puddington (U.S. Patent 2,850,451 assigned to National Research Council, Canada) silica gels, which have been conditioned at a pH of 5, have increased thickening effect in forming lubricating greases.

For example, 175 grams of sodium silicate of 41° Baumé and containing 28.7 per cent SiO_2 and 8.9 per cent Na_2O were diluted to 1 liter with distilled water. While stirring, the mixture was precipitated with 1 liter of dilute sulfuric acid containing 37 grams of 1:1 H_2SO_4-water solution. The mass, which has a pH of 6.55 was allowed to stand at room temperature for 24 hours before it was divided into four fractions each of which was broken up with 250 ml. of distilled water. While stirring vigorously, two of these lots were adjusted to pH of 5.00 and 4.00 respectively by addition of weak sulfuric acid solution. The silica suspension were then permitted to stand for 24 hours before they were washed with water and solvent exchanged with acetone.

Portions of each lot of silica-acetone amorphous gel containing 5 grams equivalent of solid silica were added to 95 grams of mineral oil having a viscosity of 300 SSU at 100°F. and a V.I. of 95. The acetone was flashed off and the mixture passed through a colloid mill

to form lubricating greases as follows:

Fraction with

pH 6.55	penetration 339
pH 5.00	penetration 279
pH 4.00	penetration 294

Silicas of this type may be rendered water-repellent by milling into the lubricant 10 to 100 per cent by weight, based on the dry weight of the silica, of a "modified" alkyl resin.

Metal Soaps of Hydroxy Fatty Acid Formals as Lubricating Grease Thickeners

Formals, which are obtained by the reaction of hydroxy fatty acids with formaldehyde, are used alone or in combination with both high molecular weight fatty acids and acetic acid to form soaps of alkalies or alkaline earth metals, which soaps in turn are used to thicken lubricating oils.

Thus, 165.5 grams of polyhydroxy stearic acid was formalized with 8.2 grams of paraformaldehyde in the presence of 0.5 grams of sodium acid sulfate and 100 grams of heptane for two hours at 107°C. and then stripped of free heptane.

A lubricating grease was then made by heating the following ingredients to 500°F., cooling to 250° F. where one-half per cent of phenyl alpha naphthylamine was added, cooling further to 200°F. and homogenizing. Two per cent of the polyhydroxystearic acid mono formal prepared above, two per cent of hydrogenated fish oil acids, eight per cent of glacial acetic acid, six per cent of hydrated lime and 81.5 per cent of mineral oil with a viscosity of 55 SSU at 210°F. were used.

The resulting lubricating grease had no dropping point, a worked penetration of 228 and was of smooth texture and insoluble in water. See: Matuszak, Morway and Munday, U.S. Patent 2,850,456, assigned to Esso Research and Engineering Co.

Manufacturing

Processes for Preparing Complex Thickened Lubricating Greases

Where soap-salt complexes are formed by neutralizing mixtures of low molecular weight acids and either intermediate or high molecular weight fatty acids, all in the presence of lubricating oil, grainy or even gritty lubricating greases may be formed.

Thompson and Richards (U.S. Patent 2,850,457, assigned to Esso Research and Engineering Co.) find that if a slurry is formed of ingredients other than the low molecular

weight acid and while the slurry is pumped through a circulating line the low molecular weight acid is slowly added simultaneously, a grit-free lubricant can be formed.

Thus, 4,250 pounds of a lubricating oil having a viscosity of 500 SSU at 100°F., 530 pounds of hydrated lime, 175 pounds of hydrogenated castor oil, and 175 pounds of hydrogenated fish oil acids were charged to a kettle and made into a slurry which was pumped through a circulating line at the rate of 50 gallons per minute. This line contained an orifice mixer and 4 inches upstream from this mixer glacial acetic acid was injected at the rate of nine pounds per minute, until a total of 695 pounds was added.

After all of the acetic acid had been added, the mass was heated to 275°F., where 1,740 pounds additional oil was added and heating continued until a temperature of 450°F. was reached. After maintaining this temperature for an hour the mixture was cooled to 250°F. where 44 pounds of phenyl alpha naphthylamine was added followed by cooling to 110°F. and passing through a Manton Gaulin homogenizer operating under a 4000 psi pressure drop. The resulting lubricating grease had a worked penetration of 292, a dropping point above 500°F. and contained no grit.

In 2,850,458 Beerbower and Bloomsburg suggest that a slurry as described above be pumped to a high intensity mixer, such as a Turbinizer or Charlotte colloid mill, while a second stream comprising C_1 to C_6 fatty acids simultaneously enters the mixer. After such mixing the mass is kettle processed as above to give a grit-free lubricating grease.

Equipment

Electrically-Heated Grease Kettle

A kettle for the manufacture of lubricating grease has its own supply of Dowtherm heated by electric immersion heaters to give operating temperatures up to 700°F. Heating efficiency is said to be higher than if an oil or gas-fired boiler were used. *Chemical Processing*, November 1958, pp. 52-3.

Radiation Damage in Lubricating Greases

B. W. Hotten and J. G. Carroll, *Ind. Eng. Chem.* 50, pp. 217-220, (1958).

Lubricating greases consisting of the following were subjected to radiations and then observed for change:

- paraffinic oil thickened with sodium stearate,
- naphthenic oil thickened with sodium stearate
- naphenic oil thickened with aluminum stearate
- diester thickened first with lithium stearate and then with a lithium-calcium soap,
- silicone fluid thickened with lithium stearate.

It was found that the colloidal structure of lubricating greases containing conventional soaps as thickeners is severely damaged by gamma radiation. Initial softening, at about 0 to 1000 megar., results from disintegration of soap crystallites which may be caused by discharge of the metal and fatty acid ions and migration of the metal ions from their normal site. The metallic and acidic fragments are then too badly separated and the latter perhaps too oil-soluble to maintain a continuous crystallic network for strong gel structure.

A hardening above about 1000 megar. probably results from oil polymerization and cross linking. Both the initial softening and final hardening may be reduced by using synthetic aromatic compounds in place of conventional gelling agents and oils.

An illustration of the latter system is octadecyl-alpha-methyl-na-

phthalene thickened with sodium N-octadecylterphthalamate.

Greases Stable to Radiation Under Dynamic Conditions

Handschy, Armstrong, and Gordon. *Lubrication Engineering*, p. 292-297, July 1958.

Development of a modified Shell roll tester permits evaluation of lubricating greases in the presence of radiation. Using this method, the dyestuff indanthrene proved extremely resistant to radiation damage and hence the limitations are the stability of the lubricating fluid.

Tests

Compatibility of Lubricating Greases

Tourret and Baker, J. *Inst. Petroleum*, 44, pp. 9-13 (1958).

Mixtures of different sodium base lubricating greases with either other sodium base products, a lithium base lubricating grease or a calcium base lubricating grease were tested for leakage on a W.B. tester. The method of mixing the lubricant before the test was of importance and 3000 strokes in a grease worker was found to give the most consistent results.

Many of the mixtures had leakages below 10 grams and the conclusions were:

"The occurrence of incompatibility of greases tested on the W.B. rig was found to be unrelated either to unsatisfactory performance of one of the components forming the mixture or to mixtures of greases containing soaps of different bases."

"Changes in penetration of the greases were confirmed not to afford a reliable indication of incompatibility."

Test Methods

Measurement of E.P. Properties Of Lubricants

P. A. Asseff, et. al. *ASTM Bulletin* 228 pp. 28-32, 1958.

A procedure, employing a Timken E.P. tester, embodies the recommendations of a Special Committee of D-2 of ASTM Technical Committee G. Cooperative tests of both E.P. fluid lubricants and E.P. lubricating greases have been made by this group.

The following statements are of interest: "Since the precision of the Timken test is generally poor, small differences between Timken values on lubricants do not necessarily indicate a significant difference in E.P. properties. However, the Timken method does differentiate between lubricants having different levels of E.P. properties, namely low, medium, or high."

Gear Lubricants

Open-Gear Lubricants

According to Beerbower and Henderson (U.S. Patent 2,814,595, assigned to Esso Research and Engineering Co.) a lubricant for open,

heavy-duty gears consists of a viscous asphaltic oil containing about 1 per cent of isobutylene-styrene copolymer and 10 per cent of trichloroethylene. The polymer reduces lubricant drippage and the chlorinated solvent thins the compound and thus contributes to ease of application.

Extreme Pressure Lubricant

According to Fischl, et. al. (U. S. Patent 2,827,433, assigned to Esso Research and Engineering Co.), the E.P. characteristics of lubricants containing phosphosulfurized hydrocarbons is improved, particularly with respect to low torque-high speed operations of hypoid gears, by the addition of 0.5 to 2 per cent of chlorodibenzyldisulfide. The major additive consists of eight to twelve per cent by weight of a dipentene-treated reaction product of a mineral lubricating oil and phosphorus pentasulfide.

Design and Testing Consideration of Lubricants for Gear Applications

Shipley, *Lubrication Eng.* 14, No. 4, pp. 148-152 (1958)

The types of gear failure related to the lubricant, namely, wear and scoring, have been investigated. A formula is given which permits some prediction as to when scoring will take place in service.

The author states "that many gear designs are completely dependent on the lubricant available and the real block to higher load carrying capacity seems to be an inadequate understanding of the lubrication phenomenon."

Effect of Air-Starved Atmosphere on Gear Load-Carrying Capacity

Southwest Research Institute have found that either a straight mineral oil, or the same containing either a phosphorous, a sulfur or a chlorine type additive, exhibited decided increases in gear load-carrying capacity when the gears were operated in an atmosphere filled with nitrogen or argon instead of air. With the air removed from the system, the load-carrying capacity was approximately doubled.

People in the Industry

SAE Elects Raymond

Leonard Raymond, chief automotive engineer for research at Socony Mobil Oil Company, Inc., was elected president of the Society of Automotive Engineers. Announcement of Mr. Raymond's election was made at the Society's annual business meeting in Detroit.

Mr. Raymond has been in automotive research since obtaining his master's degree from Columbia university in 1928. He has been active in the society for many years, and has served on a number of committees. Prior to his election he held the position of councilor of the society, and served as chairman of the publications committee.

Joining Socony Mobil in 1945, Mr. Raymond first was attached to the company's research and development laboratories at Paulsboro, N. J. He was appointed to his present position last year. He has written a number of scientific papers on engine oils, fuel additives, gear lubricants, and the use of liquefied petroleum gas as a motor fuel.

Sonneborn Announces Appointment of J. L. Kennedy

The appointment of J. Lawson Kennedy as manager of the White Oil sales division of L. Sonneborn Sons, Inc., petroleum refiners and manufacturing chemists, was announced by Rudolf G. Sonneborn, president.

The White Oil sales division is responsible for domestic marketing of Sonneborn's white oils, petrolatums, petroleum sulfonates and associated products. Mr. Kennedy succeeds R. William Bjork, who will continue his association with Sonneborn in an advisory capacity. Mr. Bjork has joined the New York securities firm of Kamen & Co. as a limited partner.

Mr. Kennedy, who is 38 years old, has been with Sonneborn for thirteen years, during which time he has held a number of key sales executive and managerial posts.

He was graduated with honors from Colgate university where he

received his bachelor of arts degree in economics and political science in 1942.

During World War II, he served for three years with the Air Force, both in the United States and in the European theatre of operations.

New Appointment in Gulf Oil's Petrochemical Department

Gene B. Brown has recently joined Gulf Oil corporation as a sales representative in the petrochemical department.

In his new position, Mr. Brown will engage in sales and sales development of Gulf's expanding line of petrochemical products. A native of Morgantown, West Virginia, he received his B.S. degree in chemical engineering from West Virginia university.

He started his career in chemical activities with the chemical operations department of the American Cyanamid company in Marietta, Ohio, in 1950. Transferred to Willow Island, West Virginia, for that company in 1953, Mr. Brown remained there until 1955, when he joined the Shell Oil company and engaged in an industrial lubricant sales capacity in Western Pennsylvania until joining Gulf.

He is a member of the American Society of Lubrication Engineers, American Chemical society, and Phi Kappa Psi fraternity.

He will be headquartered in the Gulf general offices in the Gulf building, Pittsburgh.

MacGregor Is Named Vice-President

The appointment of I. K. MacGregor as vice-president, staff operations of American Metal Climax, Inc., was announced by Walter Hochschild, vice-chairman. Mr. MacGregor had formerly served as vice-president, Eastern operations of the corporation's Climax Molybdenum company division.

Stern Is Manager

Dr. David R. Stern has been named manager of research at the Los Angeles plant of American Potash & Chemical corporation, according to an announcement by Joseph C. Schumacher, vice-president in charge of research.

The appointment was made following the recent promotion of Harold Mazza from manager of research to plant manager of the Los Angeles facility.

Stern joined the research staff of Western Electrochemical company at Culver City, Calif., in 1951 and, when that company was acquired by American Potash & Chemical corporation in 1955, was transferred to the parent company's main research laboratory at Whittier, Calif., as head of the electrochemical section. In 1956 he became assistant manager at the Whittier laboratory until the current appointment.

Tucker Is Manager For Mallinckrodt

Vernon B. Tucker was recently appointed regional sales manager by Mallinckrodt for the states of Michigan, Indiana, Ohio, Kentucky, Tennessee, Arkansas, Alabama, Mississippi, the eastern part of Illinois, and western halves of West Virginia and Georgia.

Tucker was formerly assistant regional sales manager and supervised the Cincinnati, Atlanta, and Memphis sales territories. Cincinnati will remain his headquarters as regional manager.

Tucker joined Mallinckrodt as a chemist in 1930 and beginning in 1935, served as a sales representative in the Chicago, Cleveland, and Cincinnati territories. In 1955 he was appointed assistant regional sales manager.

Houghton Promotes W. Eismann, Jr.

The appointment of William Eismann, Jr. as manager, national lubrication sales, has been announced by E. F. Houghton & Co., manufacturers of oils, packings, and chemicals.

Assuming his new duties on January 1, Eismann succeeded C. R. Schmitt who recently was elevated

to the position of assistant to the vice-president-sales, of the 95-year old Philadelphia concern.

Eismann was graduated from the University of Wisconsin in 1932, with a B.A. in Science. His employment with Houghton began in 1937 when he joined the company's research department as a grease chemist. In 1956 he became assistant to the manager of research, and in addition has served for ten years as Houghton's chief research liason on contacts with the federal government and military services.

He is a member of the American Society of Lubrication Engineers, technical representative for Houghton to the National Lubricating Grease Institute, and American Society for Testing Materials. In the latter technical society he holds chairmanship of a group studying the compatibility of hydraulic fluids in system operation, and other questions involving the field of hydraulic media.

Wamstad Is Made Assistant Manager

T. A. Wamstad was recently appointed by Mallinckrodt Chemical works to the position of assistant regional sales manager assigned to the Chicago office. He will assist E. R. Kuehne, regional manager for Mallinckrodt in the areas of Northern Illinois, Iowa, Wisconsin, Minnesota, and the Dakotas.

After joining Mallinckrodt in 1949, Wamstad was a sales representative with headquarters in Minneapolis until 1958 when he was transferred to the Chicago sales office.

American Potash Appoints Two

Two major appointments in American Potash & Chemical corporation's eastern sales department were announced at Los Angeles company headquarters by William J. F. Francis, vice president in charge of sales.

A. J. Dirksen, formerly general sales manager of the industrial chemicals division, was appointed to eastern general sales manager to be in charge of all eastern area sales. Dirksen joined AP&CC in 1953 as director of the market development department. Prior to this, he was with Phillips Petroleum corporation.

E. M. Kolb, formerly general sales manager of the heavy chemicals division, was named assistant to the vice president and will continue to be in charge of the company's potash activities. In line with this, Kolb was elected to the board of directors of American Potash Institute in addition to his duties on the board of Potash Export association.

The appointments are effective January 1, 1959, and both men will continue to operate from the company's New York Offices.

Industry News

ADM Producing Amides In Commercial Quantities

Archer-Daniels-Midland Company announced that it is producing amides, fatty nitrogen chemicals with many industrial uses, in commercial quantity.

ADM said that its Wyandotte, Michigan, chemical plant is manufacturing coco, hydrogenated tallow, stearyl, erucyl and oleyl amides from the fatty acids which the plant also produces.

The ADM amides, available through the company's development department, are the newest members of the company's expanding line of fatty nitrogen compounds. These products are marketed under the trade name Adogen.

ADM amides are distinguished by their very light color. This is especially important in the use of amides in textile finishes.

Other applications of the amides are as foam stabilizers in detergents; in durable water repellants; in plastic films as anti-block agents and lubricating additives; to improve the penetration, flexibility and translucency of wet-waxed paper coatings; to improve adhesion of printing inks; to assist the wax phase of waterproofing and protective coatings emulsions to exhaust into textiles, masonry, metals and paper.

Amides also are used as mutual solvents for waxes and resins, viscosity modifiers and melting point improvers. They have application in the manufacture of plastics, pressure sensitive tapes, molded rubber products and as wire drawing lubricants.

PPC Reports on Conducted Studies

At the Petroleum Packaging committee meeting in Omaha recently the shipping case subcommittee reported on studies being made of ways and means of obtaining less expensive cases. Among the ideas being investigated are:

1. Use of end-opening cases.
2. Reduction in number of colors used in the designs for printing cases.
3. Use of gap-flap cases.

4. Diagonal packing of cans in cases.
5. Increasing number of cans packaged in a case.
6. Using lighter weight board in construction of cases.

All of these ideas have possibilities and are recommended for investigation by individual users, if interested.

The metal drum and pail subcommittee reported the National Classification Board of Motor Carriers on August 28th approved the reconditioned 20/18 gauge 55 gallon metal drum for motor transportation, effective September 28, 1958.

The wax packaging subcommittee recommended standards for wooden pallets on which to ship wax in capacities of 1,000, 1,500 and 2,000 pounds. The committee tentatively approved these recommended specifications but in order that all may have a vote in the matter suggested that the specifications be submitted to the membership for a mail ballot.

The standards subcommittee reported that the American Standards association have now published the standards for metal drums and pails which have been adopted by the PPC.

They also reported the organization by ASA of a sectional committee, MH2, on metal drums and pails and mentioned that Mr. F. W. Langner is a member representing PPC, API and Socony and Mr. C. Ray Irons is a member representing PPC and Socony.

This subcommittee also reported that the shipping case standards as adopted by PPC have been submitted to ASA for approval as American Standards.

Mr. Ira L. Solvey reported on the organization of the new government industry packaging committee to be known as Petroleum Packaging Industry Advisory Committee, PPIAC. The membership of this committee is comprised of seven petroleum company members, three members from other packaging manufacturers and representatives from all governmental agencies interested in petroleum packaging. The first meeting was held in Washington, D. C. on September 23rd, 1958. It is planned to hold a meeting prior to each PPC meeting and have a report available of the actions taken for reporting to the PPC.

A paper was presented on pallet maintenance by Mr. J. T. Tryon of Gulf.

A paper was also presented by Mr. R. T. Flaherty of the Minnesota Mining and Mfg. Co. on the use of plastics today in packages for petroleum products.

1958 Book of ASTM Standards

The first of 10 parts of the 1958 *Book of ASTM Standards* has recently been published by the Society. The book is unquestionably the American Society for Testing Materials' largest publication venture. It represents one of the main reasons for the Society's existence. Distributed throughout the world, ASTM standards are used to cover the production, purchase, and evaluation of millions of dollars worth of materials annually. The size of the book has increased steadily and rapidly and will continue to grow because as the Society's technical committees' work increases many more specifications and tests will be issued.

The increase from seven to ten parts in 1958 was necessitated by a growth in size of individual parts

to the point where they could no longer be bound economically and were becoming unwieldy in size.

The statistics alone on this monumental reference work upon which American industry is so dependent for its materials requirements are impressive. Within the ten parts will be contained 2,450 standard specifications, methods of test, definitions of terms, and recommended practices.

It is published on bible paper to conserve shelf space and weight and is bound with blue cloth covers and red backstrap. Each part is complete with a detailed subject index and a list of standards in numeric sequence.

To keep this book up to date, supplements will be issued to each part late in 1959 and 1960. As a service, a complete index is furnished without charge with each

set of particular interest to the industry:

Part 7. Petroleum Products, Lubricants, Tank Measurements, Engine Tests, 1420 pp, 227 standards (December 1958) $12.00. Petroleum (fuel oils, gasoline, Stoddard solvent, diesel fuels); lubricants; grease; engine tests; measuring and sampling; tank calibration; laboratory apparatus.

Bennett Industries Announce New Process

Bennett Industries, Inc., of Peotone, Illinois, announces their steel drum phosphating process, in which every 30 and 55-gallon steel drum passes through an eight-step process. This cleaning and phosphating procedure assures a completely clean drum without contamination from grease, dirt or oil, inside or out.

In the six-stage washer, hundreds of high pressure nozzles spray the inside and outside of the drums in each stage, cleaning and preparing the metal surface. In the final two steps, the drums are dried and the cooling is controlled so that they reach the paint spray equipment at the optimum temperature for best paint application.

The final appearance of the drums is much improved by this surface preparation and the Bennett phosphated drums conform fully to government specifications. The film of phosphate coating provides a continuous superior surface that inhibits both rust and corrosion and provides a base for better exterior paint and lining adhesion.

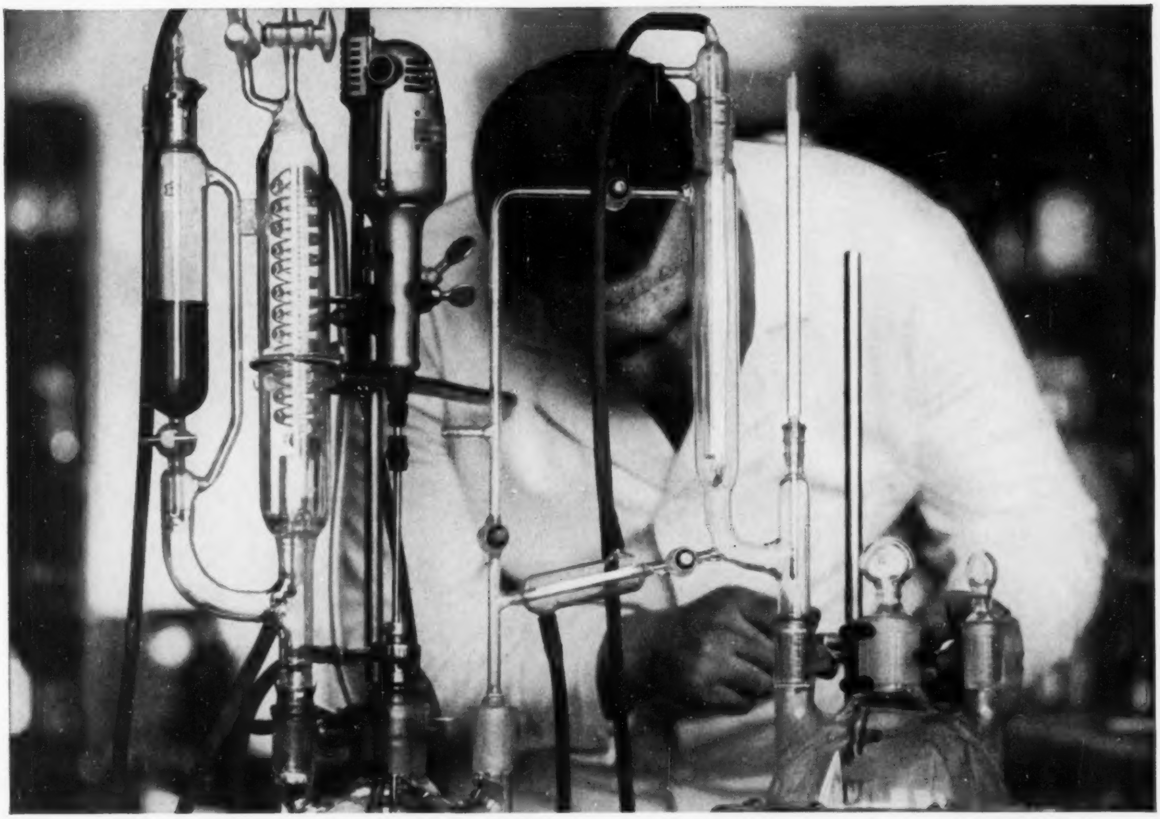
Woburn Corp. Completes Expansion

Woburn Chemical Corp., 1200 Harrison avenue, Harrison, New Jersey, the leading producer of specification fatty acids, synthetic leum marketing equipment and is drying oils and other organic chemicals, announces the completion of expansion to their existing hydrogenation facilities. In line with Woburn's research program, several new products will be introduced. The installation of a hydrogen production plant will follow quickly.

M-R-C Laboratories Design New Grease Test Spindle

The M-R-C Research Laboratories have designed, built and tested a new, two-bearing, belt-driven grease test spindle which can produce bearing thrust loads ranging from 0 to more than 1000 pounds. This spindle uses the M-R-C 204-S-17 standard grease test bearing and is fabricated from high temperature material to withstand temperatures as high as 1000° F. M-R-C Research Laboratories are in a position to furnish these spindles, ready for use in conjunction with mounting stand, oven and control equipment specified in Federal Test Method Std. No. 791 (Tentative Standard Method 333-T), CRC Method L-35 and ABEC Technical Bulletin No. 5 procedures.

For price and delivery contact: Marlin-Rockwell Corporation, Jamestown, New York.



How organic chemists put lithium to work

Recent interest in organolithium compounds owes much to the fact that these compounds are soluble in hydrocarbons. The reactions of the organolithium compounds resemble those of organomagnesium compounds, yet have distinct advantages. In solution, lithium compounds exhibit a degree of reactivity intermediate between alkali and magnesium reagents.

Where it is necessary to use ether solvents, it is found that organosodium compounds decompose most ethers too rapidly. The organomagnesium compounds have too slow a reaction rate to be useful. With organolithium compounds the desired reaction can be completed before the ether is substantially attacked.

To produce intermediates for further reaction, certain ethylenic and aromatic systems add lithium and other alkali metals to give metallic derivatives. Lithium appears to react more readily than sodium or potassium and sometimes follows a different course of reaction.

Lithium metal and lithium alkyls seem to have the ability to direct the course of a polymerization. Isoprene has been polymerized to a product containing over 93% cis-1,4 addition product. Such polymers are considered to be the nearest approach to natural rubber. This stereospecific behavior of lithium catalysts may be useful in other organic reactions.

Reduction by means of alkali metals can be accomplished by using sodium in high-boiling solvents and in liquid ammonia. Recently it has been reported that the use of lithium often gives better yields. The versatility of lithium as a reducing agent in ethylenic and aromatic compounds is shown by the selective reduction of the carbon-carbon double bond of a conjugated ethylenic ketone using lithium in liquid ammonia. A contrasting example is the selective reduction of the carbonyl group of an unsaturated ketone using lithium aluminum hydride.

But this is only the beginning. Though the information on lithium in organics is relatively limited, its vast potential in this field is already well established. We'll be glad to share this information with you if it can help you in any way with your specific organic problem. Address letterhead request to Technical Literature Department, Foote Mineral Co., 402 Eighteen W. Chelten Bldg., Phila. 44, Pa.

FOOTE MINERAL COMPANY

LITHIUM CHEMICALS, METAL, MINERALS • STRONTIUM CHEMICALS • WELDING GRADE • FERRO ALLOYS • ELECTROLYTIC MANGANESE METAL • STEEL ADDITIVES • COMMERCIAL MINERALS AND ORES • ZIRCONIUM, TITANIUM, HAFNIUM (IODIDE PROCESS)